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Prevalence of Antibodies to Hepatitis A, C, and E Viruses in Different Ethnic Groups in French Guiana

Antoine Talarmin,[1]* Mirdad Kazanji,[1] Thierry Cardoso,[2] Jean-François Pouliquen,[1] Joëlle Sankale-Suzanon,[2] and Jean-Louis Sarthou[1]

[1]*Laboratoire de Virologie, Institut Pasteur de la Guyane, Cayenne, French Guiana*
[2]*Service Départemental de Protection Maternelle et Infantile de la DASS-Guyane, Cayenne, French Guiana*

In order to determine the prevalence of antibodies to hepatitis A, C, and E viruses (HAV, HCV, and HEV) in the various ethnic groups and areas of French Guiana, sera (996 for HCV and HEV, 941 for HAV) were tested for antibodies to these viruses using ELISAs.

Differences in HAV seroprevalence were found for different age groups, with a large increase in people aged 20–30 years in comparison with those under 20. After logistic analysis, significant differences were found between places of residence; the prevalence of anti-HAV was higher along the Maroni and Oyapock rivers than in the littoral area. The ethnic differences that were observed were generally due to differences in residence. Of all sera, 5.3% were positive for anti-HCV in preliminary tests, but only 1.5% remained positive after confirmation. Brazilians were significantly more frequently infected by HCV than other ethnic groups (4.7%).

Sixty-four sera (6.4%) had antibodies to HEV, and differences were found between ethnic groups. Persons of ethnic groups who had emigrated recently to French Guiana had significantly higher seroprevalence rates: 14.6% for Chinese and Hmongs [odds ratio (OR), 4.4; 95% confidence interval (CI), 1.8–10.7], 13.5% for Brazilians (OR, 4.1; CI, 1.8–9.4), and 10.6% for Haitians (OR, 3.1; CI, 1.1–8.7). ***J. Med. Virol. 52:430–435, 1997.***

KEY WORDS: hepatitis A, C, E; seroprevalence; French Guiana

INTRODUCTION

Viral hepatitis is a major global public health problem. The term is used to describe various diseases caused by a variety of viruses with different genomes and routes of transmission [Brechot et al., 1995]. Sensitive, specific serological tests have now become available to determine the prevalence of infection with these viruses.

Hepatitis A virus (HAV) is the main agent of enterically transmitted hepatitis. Infection with this virus is very frequent in developing countries, with almost every individual over 5 years of age having been infected [Mayorga Perez et al., 1996]. In contrast, HAV is less frequent in developed countries owing to better and cleaner water supplies and standards of hygiene. In 1990, the prevalence of antibodies to HAV among French military recruits was 21.4%, 9% lower than in 1985 [Joussemet et al., 1992]. This reduction in HAV prevalence in industrialized countries has been accompanied by a change in the clinical presentation of HAV infection, the severity increasing with age, with a greater rate of fulminant hepatitis [Forbes and Williams, 1990].

Hepatitis C virus (HCV), first identified in 1989, was recognized rapidly as the cause of the majority of non-A, non-B post-transfusion hepatitis. Infection with HCV, frequently results in chronic hepatitis leading to cirrhosis, and in some cases, hepatocellular carcinoma. It is thus a serious public health problem [Alter et al., 1992; Jeng and Tsai, 1991]. HCV seroprevalence rates differ with geographical location. For example, rates of 0.22% among blood donors in France [Aymard et al., 1992], 0.36% in the United States [Murphy et al., 1996], 3.3% in a healthy population in Madagascar [Morvan et al., 1994], and to 13.6% among Egyptian blood donors [Darwish et al., 1993] have been determined using recombinant immunoblot assays.

Hepatitis E virus (HEV) appears to be the second most frequent cause of enterically transmitted hepatitis after hepatitis A virus (HAV). Infection with HEV results in acute hepatitis, which is associated with high mortality rates in pregnant women, especially during

*Correspondence to: Dr. A. Talarmin, Laboratoire de Virologie, Institut Pasteur de la Guyane, B.P. 6010, 23 Av. Pasteur, 97306 Cayenne Cedex, Guyane Française.

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the third trimester of pregnancy [Myint et al., 1985; Sarthou et al., 1986]. Many outbreaks of HEV-induced hepatitis have been recorded in India, South East and Central Asia, Africa, and Mexico [Bradley, 1992]. High seroprevalence rates have been reported in many developing countries [Pawlotsky et al., 1995], and low rates have been described in some developed countries [Zanetti et al., 1994]. Although antibodies to HEV have been found in sera from individuals in Venezuela and Brazil [Pujol et al., 1994; Pang et al., 1995], little is known about anti-HEV seroprevalence in South America.

Data on the rates of infection by hepatitis B virus (HBV) in French Guiana are available from the Center for Mother and Child Protection, from results of systematic HBV serology testing during pregnancy. However, the prevalence of seropositivity for other hepatitis viruses is unknown. The present study was undertaken to determine the seroprevalence of antibodies to HAV, HCV, and HEV, and to help assess the value of anti-HAV vaccination in French Guiana.

SUBJECTS AND METHODS

Region and Population

French Guiana is an overseas French *département* (administrative unit) in the Amazonian forest complex on the northeast coast of the South American continent between Brazil and Surinam. Ninety percent of its surface of 83,500 km² is tropical rain forest; the remaining 10%, in the northern part of the country, is a littoral plain where 90% of the 136,000 inhabitants live. The main urban centres are Cayenne, Remire-Montjoly, and Matoury, with a total of 80,000 inhabitants. The population is made up of a large variety of ethnic groups. Fifty percent are Creoles who are of mixed European and African descent; the remainder are Amerindians (4%); Noir-Marrons (5.4%); immigrants from Haïti (20%), the Amazonian region of Brazil (4.3%), and various Asian countries (Chinese, Hmongs) (2.1%); and Caucasians, mainly from metropolitan France (14.2%). The Noir-Marrons are an ethnic group of African origin, descendants of slaves who escaped from Surinam during the eighteenth century; they are virtually unmixed with other populations, and have reconstructed a tribal way of life. Hmongs emigrated from Laos in 1979 and lead a traditional way of life in two villages. Chinese immigration began in the mid-nineteenth century and continues, as does that from Haïti, which began in 1970, and that from Brazil. Most of the younger members of these populations were born in French Guiana. The population of the littoral plain, and especially of Cayenne, consists of Creoles, Haïtians, Caucasians, and Brazilians. Brazilians also live along the Oyapock river with Amerindians, whereas the population along the Maroni river consists of Noir-Marrons and Amerindians. The Chinese population is scattered across French Guiana, although most live on the littoral plain.

Sera Collection

The sera were selected randomly from several large banks of sera stored at −80°C, collected either for epidemiological studies on human T-cell leukemia/lymphoma virus type I, during routine testing of pregnant women, or for the identification of arboviruses. The samples were representive of all of the ethnic groups and areas of French Guiana.

Serological tests for hepatitis E and C were performed on sera collected between January 1992 and April 1996, from individuals over 20 years of age. In order to avoid the risk of false positivity due to a previous vaccination, only sera collected from 1992 to January 1995, were tested for antibodies to HAV. Because HAV seroprevalence was expected to be high, sera taken from the same collections, from individuals under 20 years of age, were also tested.

Serological Tests

Sera were tested for antibodies to HAV and HEV by commercial enzyme immunoassays (HAV Total, Sanofi Diagnostics Pasteur, Marnes la Coquette, France; and Abbott HEV EIA, Abbott Laboratories, Rungis, France, respectively).

All sera were tested initially for HCV antibodies by an ELISA screening test (Abbott HCV EIA 3.0, Abbott Laboratories, Rungis, France) that detects for antibodies to recombinant proteins coded by putative structural (HC-34 and HC-43) and non-structural (NS5 and c100-3) regions of the HCV genome. All sera that were reactive in the screening test were then tested by a dot-blot immunoassay (Abbott Matrix, Abbott Laboratories, Rungis, France), as described previously [Vallari et al., 1992]. Only sera reactive with at least two antigens (Core, NS3, or NS4) were considered to be positive; sera reactive with only one antigen were considered as indeterminate, as recommended by the manufacturer.

All of the tests were carried out according to the manufacturer's instructions, and positive and negative controls supplied with the tests were included. For anti-HCV screening, serum from a patient known to be HCV-positive was also included in each trial.

Statistical Analysis

The groups were compared using the chi-square or Fisher's exact tests. Odds ratios (OR) were calculated to evaluate the association between specific variables and prevalent hepatitis infections. In order to assess the statistical significance of the association, 95% confidence intervals (CI) and the chi-square for trends were used. A stepwise logistic regression analysis was performed to select significant, independent determinants of seropositivity to HAV.

RESULTS

A total of 941 sera (from 500 women and 441 men; mean age 31,2 ± 15,6; range, 1-80 years) were tested for antibodies to HAV, and 996 sera (from 587 women and

TABLE I. Seropositivity for Antibodies to Hepatitis A Virus in French Guiana

Variable	No. of sera	Seropositivity			Crude		Adjustment for age		Logistic analysis	
		No	%	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age (years)										
<10	90	28	31.1	21.5–40.7	1					
10–19	95	32	33.7	24.2–43.2	1.1	0.6–2.1				
20–29	277	204	73.6	68.5–78.8	6.2	3.8–10.1				
30–39	238	174	73.1	67.5–78.7	6.0	3.6–10.0				
>40	241	209	86.7	82.4–91.0	14.5	8.5–24.4				
Place of residence										
Cayenne	426	274	64.3	59.8–68.9	1					
Cacao	23	18	78.3	61.4–95.1	2.0	0.7–5.4	1.8	0.7–4.8		
Bas-Maroni	20	18	90.0	—	5.0	1.3–19.0	9.6	2.0–45.6		
Haut-Maroni	255	185	76.1	70.8–81.3	1.8	1.2–2.5	4.6	3.0–7.2		
Littoral	135	85	63.0	54.8–71.1	0.9	0.6–1.4	1.2	0.8–1.8		
Oyapock	82	67	81.7	73.3–90.1	2.5	1.4–4.4	3.4	1.9–6.1		
Ethnic group										
Creole	228	143	62.7	56.4–69.0	1		1		1	
Amerindian	91	71	78.0	69.5–86.5	2.1	1.2–3.7	1.9	1.1–3.4	1.3	0.6–2.5
Caucasian	153	81	52.9	45.0–60.8	0.7	0.4–1.0	0.6	0.4–0.9	0.6	0.4–0.9
Brazilian	107	82	76.6	68.6–84.6	1.9	1.2–3.3	1.9	1.1–3.5	1.0	0.5–2.0
Chinese	24	19	79.0	62.9–95.4	2.3	0.8–6.1	2.3	1.0–5.5	2.8	0.9–8.9
Hmong	38	32	84.2	72.6–95.8	3.2	1.3–7.6	4.2	1.6–10.8	3.5	0.8–14.5
Haitian	66	52	78.8	68.9–88.6	2.2	1.2–4.2	1.5	0.8–2.7	1.6	0.8–3.3
Noir-Marron	234	167	71.4	65.6–77.2	1.5	1.0–2.2	3.6	2.2–5.8	1.9	0.8–4.8
Total	941	647	68.7	65.8–71.7						

OR, odds ratio; CI, confidence interval.

409 men; mean age, 35.1 ± 12.5; range, 20 to 80 years) for hepatitis C and E.

Prevalence of HAV Antibodies

Antibodies to HAV were found in 647 of 941 sera (68.8%), and the seroprevalence increased significantly with age (trend test, $P < 0.0001$) with a very substantial increase between the <20 and the 20–29 age groups. Age >20 was associated with a significant risk for HAV seropositivity (OR, 6.2; CI, 3.8–10.1). The seroprevalence rate differed significantly according to the place of residence (trend test, $P < 0.001$). The lowest rates were found in Cayenne and the littoral area, and the highest along the Maroni and Oyapock rivers. These differences persisted after adjustment for age (Table I). Differences in seroprevalence among the various ethnic groups were also assessed (trend test, $P < 0.001$). Noir-Marrons and Hmongs had the highest risks after adjustment for age, and Caucasians had the lowest. After logistic analysis, only the results for Caucasians remained significantly different from those for the other ethnic groups, with a lower risk for HAV seropositivity (OR, 0.6; CI, 0.4-0.9) (Table I).

Prevalence of HCV Antibodies

Antibodies to HCV were found in 53 of 996 sera (5.3%) and the positivity was confirmed for 15 samples (1.5%). Fifteen additional sera reacted against only one antigen (11 against the core antigen, 3 against NS3, and 1 against NS4). No significant difference in HCV seropositivity (after confirmation) was seen between age groups or between places of residence; however, the percentage of HCV seropositivity was significantly higher in Brazilians (4.7%) than in the other ethnic groups ($P < 0.01$) (Table II).

Prevalence of HEV Antibodies

Of the 996 sera tested, 64 (6.4%) were repeatedly positive (reactive above the cutoff value recommended by the manufacturer), and 4 were intermediate (reactive within an indeterminate zone: optical density cutoff, 10%) (Table III). Seropositivity to HEV did not increase with age, but differences were observed between places of residence (trend test, $P < 0.05$), and significantly fewer residents of the Haut-Maroni area were seropositive than in other areas. The seroprevalence rates differed significantly between ethnic groups (trend test, $P < 0.001$), with higher rates among Brazilians (OR, 4.1; CI, 1.8–9.4), Chinese and Hmongs (OR, 4.4; CI, 1.8–10.7), and Haitians (OR, 3.1; CI, 1.1–8.7). These differences remained after adjustment for age (Table III).

DISCUSSION

The seroprevalence of HAV in French Guiana was intermediate between that of the United States and Europe, where HAV seroprevalence is very low [Szmuness et al., 1977], and that of developing countries, where the rates are much higher, especially among children [Tsega et al., 1990]. The large differences in rates found between areas correlated with the methods used to obtain drinking water. In Cayenne and on the littoral area, the floculation, filtration, and chlorination systems are used which are similar to those installed in other parts of metropolitan France; along the Oyapock river and in the Bas-Maroni area, only chlo-

TABLE II. Prevalence of Antibodies to Hepatitis C Virus by Ethnic Groups in French Guiana

		Seropositivity		
Ethnic group	No.	No.	%	95% CI
Creole	189	2	1.1	—
Amerindian	158	0	0	—
Caucasian	183	4	2.2	—
Brazilian	148	7	4.7	1.3–8.1
Chinese and Hmong	96	0	0	—
Haitian	66	1	1.5	—
Noir-Marron	156	1	0.6	—
Total	996	15	1.5	0.7–2.2

CI, confidence interval.

rination kits are used, and in the Haut-Maroni area the purification system is known to be unreliable, as its capacity is insufficient to supply all of the surrounding villages. The results of water analyses are usually satisfactory in Cayenne and the littoral zone, but the bacteriological characteristics of drinking water along the Maroni and the Oyapock rivers are therefore usually poor (Terrien et al., 1996). Furthermore, some of the chlorination systems were installed only recently, and most of the individuals tested were undoubtedly infected previously. Other differences in the standards of hygiene between people living in the coastal areas (including Cayenne), and those living along the Maroni and Oyapock rivers may also explain the differences in HAV seroprevalence rates. Whereas running water and toilets exist everywhere on the coast, only about 70% of the inhabitants along the rivers have access to running water, most of the Noir-Marrons have latrines, and Amerindians usually have no sanitary facilities. Furthermore, since sewage works do not exist along the Maroni and Oyapock rivers, the faecal contamination of the rivers is continuous. Overcrowding, frequent in the Haut Maroni and the Haut Oyapock due to high birth rates among Noir-Marrons and Amerindians, is also a risk factor for HAV infection.

The ethnic differences we observed in this study are generally due to the fact that some ethnic groups (Amerindians, Hmongs, and Noir-Marrons) are isolated in their villages. Only the results for the Caucasians remained significantly different from those for the other groups after logistic analysis, with a lower HAV seroprevalence. Caucasians, who are mainly metropolitan French, usually live in French Guiana for only a few years, and their HAV seroprevalence is almost the same as that in metropolitan France. The prevalence of HAV antibodies in the urban centres of French Guiana, however, is similar to that observed in developed countries, especially in people under 20 years of age. The large increase observed in older persons is probably due to the inadequate sanitation facilities that existed before recent improvements. Although there are differences between rural and urban areas, the situation in rural areas is much better than that in developing countries, where the average age of acquisition of HAV is about 2 years of age [Mayorga Perez et al., 1996].

These results question the value of the vaccination against HAV in French Guiana, which is believed to be useful for the protection of individuals, especially adults at high risk of the disease, such as those traveling to highly endemic regions. The cost of the vaccination and the relative mildness of the disease, however, do not currently justify widespread childhood immunization [Lemon, 1994]. Because of the differences observed between areas, vaccination should be recommended for French Guianese living on the littoral and traveling along the Maroni and Oyapock rivers, or to developing countries. Older individuals should be vaccinated only after HAV serology. Vaccination would appear to be less useful for the population living along the Maroni and Oyapock rivers, since the adults are likely to have been infected by HAV.

The rates of HCV seroprevalence observed in French Guiana are not very different from those observed in metropolitan France [Aymard et al., 1993], except among Brazilians, whose rate (4.73%) was similar to those observed in developing countries [Ndumbe and Skalky, 1993], and higher than those described previously in some Brazilian studies of Brazilian blood donors: 1.4% in Central Brazil [Martins et al., 1994] and 2.7% in Rio de Janeiro [Vanderborght et al., 1993]. Apart from sampling bias, there are at least three possible explanations for this difference. First, blood donors undergo pre-donation selection and screening for risk factors, and so the prevalence of hepatitis viruses and other viruses in this population is lower than in the general population. Second, HCV seroprevalence is known to be higher in groups of low economical status [Murphy et al., 1996], as is common among immigrants. The Brazilian population living in French Guiana may therefore not be representative of the Brazilian population of Brazil. Third, the Brazilians who live in French Guiana are emigrants from Amapa and Para states, whereas the above-mentioned studies were conducted in Central and Southeast Brazil. Seroprevalence rates may differ between the different regions of Brazil.

The more isolated populations, such as the Amerindians and Noir-Marrons, appeared to have lower seroprevalence rates than the other ethnic groups, but this observation should be confirmed by further studies.

The overall HCV seroprevalence rate in French Guiana (1.5%) is high. Complications due to HCV infection may consequently become a problem in the near future. The presence of risk factors such as intravenous drug use and previous blood transfusion was not known, but intravenous drug use is very rare in French Guiana. The patterns of infection with HCV seem to be different than those with HBV:HBV surface antigen was found in 3.2% of all pregnant women in 1993, and Hmongs had a much higher rate of seroprevalence than other ethnic groups (Center for Mother and Child Protection, personal communication).

The prevalence of antibodies to HEV was lower than in some African and Asian countries [Bradley, 1992], but similar to the 6% previously described in Brazil [Pang et al., 1995], and the 4% in Venezuela [Pujol et

TABLE III. Seropositivity for Antibodies to Hepatitis E Virus in French Guiana

Variable	No. of sera	Seropositivity			Crude		Adjustment for age	
		No.	%	95% CI	OR	95% CI	OR	95% CI
Age (years)								
<30	394	24	6.1	3.7–8.4				
30–39	312	19	6.1	3.4–8.7				
40–49	158	12	7.6	3.5–11.7				
>50	132	9	6.8	2.5–11.1				
Place of residence								
Cayenne	421	35	8.3	5.7–10.9	1		1	
Cacao	39	4	10.3	—	1.3	0.4–3.8	0.6	0.2–5.5
Bas Maroni	63	3	4.8	—	0.6	0.2–1.9	0.4	0.1–1.7
Haut Maroni	174	2	1.1	—	0.1	0.0–0.4	0.13	0.0–0.5
Littoral	131	12	9.2	4.2–14.1	1.1	0.6–2.3	1.1	0.5–2.2
Oyapock	168	8	4.8	1.5–8.0	0.6	0.3–1.2	0.7	0.3–1.5
Ethnic group								
Creole	189	7	3.7	1.0–6.4	1		1	
Amerindian	158	9	5.7	2.1–9.3	1.6	0.6–4.3	2.0	0.7–5.5
Caucasian	183	6	3.3	0.7–5.9	0.9	0.3–2.7	0.9	0.3–2.8
Brazilian	148	20	13.5	8.0–19.0	4.1	1.8–9.4	4.8	1.9–11.9
Chinese and Hmong	96	14	14.6	7.5–21.6	4.4	1.8–10.7	4.0	1.5–10.9
Haitian	66	7	10.6	3.2–18.0	3.1	1.1–8.7	3.3	1.1–9.9
Noir-Marron	156	1	0.6	—	0.1	0.0–1.1	0.2	0.0–1.5
Total	996	64	6.4	4.9–7.9				

OR, odds ratio; CI, confidence interval.

al., 1994]. In contrast to infection with HAV, no difference was seen by age; however, members of ethnic groups who had immigrated recently to French Guiana had significantly higher seroprevalence than longer-term residents. Most of these immigrants came from countries either known [Lok et al., 1992] or likely to have higher HEV seroprevalence rates than French Guiana, and may have been infected before their emigration. Because most immigrants are in their twenties when they arrive in French Guiana, those over 20 would have immigrated earlier; this may explain why we observed no increase with age, unlike other studies [Mayorga Perez et al., 1996]. Thus the overall HEV seroprevalence in individuals likely to have been infected in French Guiana [Creoles, Amerindians, and Noir-Marrons] is low (3.4%) and is similar to that observed in Caucasians. In an area where no severe acute hepatitis has been reported in pregnant women, the 3.4% HEV seropositivity could be due to poor specificity of the ELISA, which is difficult to evaluate due to the absence of a confirmatory test. Since positive samples with high optical density were detected equally frequently in all ethnic groups, and since the higher HEV seroprevalence rates were found in individuals coming from Asia where HEV is frequent, the specificity of the test is probably quite good.

In conclusion, this first study concerning of the HAV, HCV, and HEV seroprevalence in French Guiana indicates that hepatitis E is not a public health problem in this French overseas *département*, and that whereas the seroprevalence of hepatitis A is likely to decrease due to improvements in the water supply, hepatitis C will become responsible for cases of chronic hepatitis in the near future.

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